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Full Length Research Article

IN-FIELD SOIL FERTILITY ASSESSMENT OF RAMAT POLYTECHNIC FARM MAIDUGURI IN NORTH-EASTERN NIGERIA

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ABSTRACT
In-field soil fertility valuation is an important diagnostic tool for determining the nutrient needs of plants. The main objective was to determine soil chemical characteristics. Twenty samples covering 2.5 hectares of the farm from 0-30 cm depth (< 2mm fraction) processed and analysed in the laboratory. The soils are in a state of equilibrium from the C: N ratio (14.50 to 35.00), influencing the biogeochemistry of carbon, nitrogen, and phosphorus in pedogenetic development. There was high exchangeable calcium (6.20 Cmolkg^{-1} to 12.40 Cmolkg^{-1}) and magnesium (1.00Cmolkg-1 to 4.80Cmolkg-1). Potassium contents were found to be medium to high (0.27 Cmolkg^{-1} to 1.54 Cmolkg^{-1}). Available phosphorus ranged from low to medium contents (1.40 mkg^{-1} to 22.05 mkg^{-1}) in all the samples. Cation exchange capacity (CEC) ranged from 10.01 Cmolkg^{-1} to 0.41 Cmolkg^{-1} and percent base saturation was high having >80%. Parent materials (sedimentary deposits) had influenced the availability of phosphorus and the exchangeable bases on the farm. These findings conclude that the soils have a high fertility status. However, there are slight hazards of salinity.

Keywords: Chemical properties, Fertility assessment, Infield variability, Soil

INTRODUCTION

Soil fertility institute availability of nutrient status, and its aptitude to provide nutrients out of its own reserves and through exterior applications for crop production (Reddy, 2013). Soil fertility is a complex soil index and important component of overall soil productivity. In recent time Wang *et al.* (2018), reported that soil fertility degradation is aided more by climate change and described it as one of the most important constraint to food security. Soil fertility degradation implies a decline in soil quality with an attendant reduction in ecosystem functions and services (Lal, 2015).

The in-field spatial variability of an area is dynamic within each growing season and between growing seasons. Temporal variability occurs both within and between seasons. The precision agriculture or smart farming is often associated with site-specific fertilisation for an improved degree of precision in nutrient management, to outperform existing techniques (Kamilaris & Prenafeta-Boldú, 2018). In-field fertility variability can have a significant influence on agricultural production by reducing the quality and quantity of yield (Smith *et al.,* 2009). Among the spatial factors responsible for yield variability include fertility gradient and other nutritional properties. Therefore, soil fertility assessment within the field becomes a rudiment in the decision-making tool for sustainable soil nutrient management.

The focus of this study was on the soil chemical degradation characterized by essential plant nutrients loses or toxicities. Crops take up nutrients from the soil through agricultural production and crop residues. The continuous research cycle largely agronomic with less or no attention is given to the soil fertility condition or status of the farm. This has always demanded a supplemental source of nutrients (organic or inorganic) besides. The use of chemical fertilizers in supplementing the soil requirement has been increasing steadily, raising some fertility concerns, and a sustained or improved soil fertility management has been an important factor in production. Optimum productivity of a cropping system depends on the adequate supply of plant nutrients. Continues removal of the nutrients from the soil with little or no replacement ensures future nutrients related yield loss and poor research outcome, the foundation on which all input-based high-production systems can be built. Soil analysis or test is a reliable tool used in evaluating and predicting the fertility rank of a soil, thus it was employed as a diagnostic tool for management strategies in improving soil fertility for increased production. This study aimed to assess the infield fertility status in terms of their chemical characteristics of Ramat Polytechnic teaching and research farm.

MATERIALS AND METHODS

The study sites

The study site is located within Ramat Polytechnic in Maiduguri Metropolitan of Borno State situated between the 11.8360°N and 13.1323° E. The climate is dry sub-humid in nature as described by Ojanuga (2006), characterized by unimodal rainfall pattern. Mean daily temperatures during the cropping season ranged between 23.2 and 34.3^{o}C.

Environmental characteristics of the study site

The geologic formation was an initiative in the upper Cretaceous. The Bima sandstone overlies the basement rocks unconformably. There was an intense folding of the Cretaceous formations at the end of the Cretaceous, leading to the formation of several anticlinal features and erosional activities partly wearing away the upper Cretaceous strata thereby creating an unconformity surface (Okpikoro and Olorunniwo 2010). The sedimentation commenced with the deposition of continental poorly sorted, sparsely fossiliferous, medium to coarse-grained sandstone (Bima Formation) lying directly in the basement (Boboye and Abimbola, 2009).

The study site is getting sparsely vegetated as a result of the climatic changes and overexploitation, the vegetation that used to consist of scrubs interspersed with occasional trees and parches of woodland is fast disappearing. Land degradation and desertification have been on the upsurge (Waziri *et al.,* 2009). Agriculture is the main economic activity in the area (Onwualu, 2009). These activities (Farming and livestock rearing) with high and increasing demand for fuelwood have contributed greatly to environmental degradation.

FIELD STUDY

Soil sampling and processing

The standard diagonal soil fertility sampling method was used, sampling was in diagonal direction from one end of the farm to the other; each sample was taken using auger at a distance of 8m to cover 2.5 hectares of the farm. From the site under study, 20 composite samples (each being a composite of five sub-samples) collected from 0-30 cm depths (representing the surface). The samples were air-dried and stored in soil sampling bags for laboratory analysis.

LABORATORY ANALYSES

Sample preparation and chemical analyses

Soil samples were air dried, crushed and passed through a 2mm manual sieve. All chemical analyses were carried out on the < 2mm fraction.

Organic carbon content of the soil was determined (Nelson and Sommers, 1996). The soil was oxidized with standard potassium dichromate solution and sulphuric acid-generating heat of reaction, followed by titration of the excess dichromate with 0.5 N ferrous sulphates using ortho-phenonthroline as an indicator. Total nitrogen determined by the macro-Kjeldhal method as reviewed by Bramner (1965) after digesting the soil sample with sulphuric acid. Available P determined by the Bray No.1 extraction method (Bray and Kurtz, 1945). Na and K determined using the flame photometer, while Cation Exchange Capacity (CEC) of the soils determined by saturating the soil with normal neutral ammonium acetate solution, washing excess with alcohol. The exchangeable bases determined using the ammonium acetate extract from CEC determination; the samples further distilled and titrated against standard hydrochloric acid. Base saturation calculated by dividing the summation of the exchangeable bases by NH_4OA_C Cation Exchange Capacity (CEC) of the soils.

RESULTS AND DISCUSSION

Chemical Properties

Soil Reaction (pH)

The pH values in all the locations were slightly acid to neutral, mean values varying from 6.36 -7.21. Such pH values are within the range best for crop growth and fertilizer use (Jones Jr, 2012). The pH values were consistently the least variable CV (0 – 15%), in all the soil units.

Organic Carbon

The organic carbon content of the soil was low as per the rating scale of Esu (1991). The mean organic carbon contents vary from 0.26gkg^{-1} to 0.60gkg^{-1}. All of which fall within the low rating as per the rating scale (Table 1 and 2). The low carbon contents due to intrinsic low organic matter contents, this may have accounted for the low growth of crops and natural vegetation. The rapid turnover rates of organic material as a result of high soil temperatures, fauna activity, and low soil clay content have influenced the organic matter contents as earlier reported by Bationo *et al.* (2007).

Table 1: Critical Limits for interpreting levels of analytical parameters

Rating				
Parameter	Low	Medium	High	Units
Ca^{++}	< 2	2 – 5	> 5	cmol (+) kg^{-1}
Mg^{++}	< 0.3	0.3 – 1.0	>1.0	cmol (+) kg^{-1}
K^{++}	< 0.15	0.15 – 0.30	> 0.30	cmol (+) kg^{-1}
Na^{+}	0.1	0.1-0.3	>0.3	cmol (+) kg^{-1}
CEC	< 6	6 – 12	> 12	cmol (+) kg^{-1}
Organic C	< 10	10 – 15	>15	gkg^{-1}
Total N	< 0.1	0.1 – 0.2	> 0.2	gkg^{-1}
Available P	< 10	10 – 20	> 20	mkg^{-1}
Base Saturation	< 50	50 – 80	> 80	Percent

Source: Esu, 1991

Also, the organic carbon contents were influenced or controlled by different environmental factors, even though their dynamics are driven by soil type and land use relating to climatic factors (Adu-Gyamfi and Goh, 2017). The highest organic carbon content was obtained in location 6 which was attributed to higher amount of litter deposited on its surface.

Total nitrogen

Total nitrogen values vary from 0.1 - 0.4gkg^{-1} in the study site, similar nitrogen values classified as medium by Esu (1991). Nitrogen has been reported to be the most limiting plant nutrient in tropical soils (Brady and Weil, 2013), the average levels of nitrogen obtained attributed to the use of organic manure besides the use of inorganic nitrogenous fertilizers on the farm. Results of nitrogen contents in the studied soils were least in variability, except in locations 3, 19 and, 20 classified as highly variable (Table 2).

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Table 2: Soil pH, Organic Carbon and Total Nitrogen used in fertility assessment of the Ramat Polytechnic farm

Parameter	Location																			
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
pH	6.45	6.71	6.92	6.51	6.26	6.57	6.61	6.63	6.60	6.64	6.61	7.21	7.22	6.67	6.66	6.59	6.58	6.60	7.10	6.48
(H_2O1:1)	6.48	7.10	6.89	6.51	6.31	6.48	6.61	6.62	6.59	6.64	6.61	6.90	7.22	6.67	6.66	6.58	6.58	6.60	7.00	6.48
	6.44	6.70	6.91	6.49	6.25	6.55	6.60	6.63	7.11	6.66	6.60	6.99	7.18	6.68	6.64	6.59	6.54	6.67	7.00	6.45
Mean	6.46	6.84	6.91	6.50	6.36	6.53	6.61	6.63	6.77	6.65	6.61	7.03	7.21	6.67	6.65	6.59	6.57	6.62	7.03	6.47
SD	0.021	0.228	0.015	0.012	0.032	0.047	0.006	0.006	0.297	0.012	0.006	0.159	0.023	0.006	0.012	0.006	0.023	0.040	0.058	0.017
CV (%)	0.325	3.333	0.217	0.185	0.503	0.719	0.091	0.090	4.387	0.180	0.091	2.262	0.319	0.089	0.180	0.091	0.350	0.604	0.825	0.263
Organic C	0.39	0.31	0.37	0.29	0.25	0.33	0.18	0.33	0.21	0.43	0.33	0.49	0.82	0.53	0.45	0.55	0.39	0.31	0.35	0.23
(gkg^{-1})	0.45	0.21	0.33	0.35	0.35	0.33	0.31	0.35	0.31	0.31	0.37	0.51	0.49	0.41	0.45	0.49	0.45	0.35	0.37	0.70
	0.45	0.22	0.33	0.29	0.35	0.34	0.30	0.33	0.31	0.40	0.35	0.50	0.50	0.51	0.44	0.51	0.41	0.33	0.37	0.68
Mean	0.43	0.25	0.34	0.31	0.32	0.33	0.26	0.34	0.28	0.38	0.35	0.50	0.60	0.48	0.45	0.52	0.43	0.33	0.36	0.54
SD	0.035	0.055	0.023	0.035	0.058	0.005	0.072	0.012	0.058	0.062	0.02	0.01	0.188	0.064	0.006	0.031	0.031	0.02	0.012	0.266
CV (%)	8	22	7	11	18	2	28	4	21	16	6	2	31	13	1	6	7	6	3	49
Total N	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.04	0.03	0.02	0.03	0.02	0.01	0.01	0.01
(gkg^{-1})	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.03
	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.01	0.02
Mean	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.02	0.03	0.02	0.02	0.01	0.02
SD	0.00	0.00	0.006	0.006	0.00	0.00	0.00	0.00	0.00	0.006	0.006	0.006	0.01	0.006	0.00	0.006	0.006	0.006	0.012	0.01
CV (%)	0	0	60	30	0	0	0	0	0	30	30	30	33	20	0	20	30	30	120	50

D = standard deviation CV = Coefficient of variability, where < 15% = least variable; 15-35% =moderately variable; >35% = highly variable

C: N ratio

The C: N ratio values vary from 14.50 to 35.00 in the study site (Table 3). The results confirmed the organic matter in an equilibrium state corresponding to a well decomposed and completely incorporated soil organic matter. The fully incorporated soil organic matter plays an important role in the soil biogeochemistry of carbon, nitrogen, phosphorus, pedogenesis, and transport of pollutants in soils (Kalbitz *et al*., 2000). **T**he CV was generally found to be least in variation.

Available phosphorus

Available phosphorus varying between 1.40 mkg^{-1} and 22.05 mkg^{-1} in all locations of the study site, the soils rated having low to medium available phosphorus contents, except in location 1 where high value was obtained (Table 3). Low-medium results have shown a more consistent trend in all study sites, this could be attributed to the low phosphate potentials of the parent rock as reported by Porder and Ramachandran (2013). The result conforms to the findings phosphorus is one of the limiting nutrients in the soils of the study area (Ekeleme *et al*., 2011). The CV was varying, it was highly variable in location 5, 9, 13, 14, and 17, while other soil units were time and again least in variation.

Cation exchange capacity (CEC)

The overall cation exchange capacity (CEC) ranged from 10.01$Cmolkg^{-1}$ to 0.41 $Cmolkg^{-1}$ in the study area. The study site was placed having a "medium" to "high" class. Brady and Weil (2013) reported that the organic carbon content of the soil greatly influences its CEC. The CV was all least in variability, except in units 1 and 13, which show moderate levels of CEC, Table 4.

Table 3 C: N Ratio, Available Phosphorus and CEC used in fertility assessment of the Ramat Polytechnic farm

Parameter	Location																			
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
C:N Ratio	19.50	31.00	18.50	29.00	25.00	23.00	18.00	33.00	21.00	21.50	16.50	24.50	20.50	17.67	22.50	18.33	19.50	31.00	35.00	23.00
	22.50	21.00	33.00	17.50	35.00	33.00	31.00	35.00	31.00	31.00	18.50	17.00	16.33	20.50	22.50	16.33	22.50	17.50	12.33	23.33
	22.50	22.00	33.00	14.50	35.00	34.00	30.00	33.00	31.00	20.00	35.00	25.00	25.00	17.00	22.00	25.50	41.00	16.00	37.00	34.00
mean	21.50	24.33	28.17	20.33	31.67	30.00	26.33	33.67	27.67	24.17	23.33	21.17	20.61	18.39	22.33	20.05	27.27	21.50	28.11	26.78
SD	1.732	5.507	8.372	7.654	5.774	6.083	7.234	1.155	5.773	5.965	10.15	4.481	4.336	1.858	0.289	4.822	11.64	8.261	13.70	6.258
CV (%)	8	22	30	38	18	20	28	3	21	25	44	21	21	10	1	24	43	38	49	24
Available P	22.75	12.60	10.50	14.00	5.95	14.35	14.35	12.25	22.75	11.90	8.05	5.95	14.35	18.55	12.25	4.90	1.40	4.55	4.20	5.25
(mkg^{-1})	22.05	18.55	18.55	22.05	17.85	11.55	8.75	7.35	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
	22.10	18.52	10.60	14.04	17.86	11.55	8.76	12.22	7.71	11.68	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
mean	22.30	16.56	13.22	16.70	13.87	12.48	10.62	10.60	12.72	10.43	7.82	7.12	9.92	11.32	9.22	6.77	5.60	6.65	6.53	6.88
SD	0.391	3.427	4.619	4.636	6.873	1.617	3.230	2.820	8.686	2.364	0.202	1.010	3.839	6.264	2.627	1.6167	3.637	1.819	2.021	1.415
CV (%)	2	21	34	28	50	13	30	27	68	23	3	14	39	55	28	24	65	27	30	21

D = standard deviation CV = Coefficient of variability, where < 15% = least variable; 15-35% =moderately variable; >35% = highly variable

Table 4: Cation Exchange Capacity (Cec), Calcium (Ca^{++}), Magnesium (Mg^{++}) Used In Fertility Assessment of the Ramat Polytechnic Farm

Parameter	Location																			
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
CEC	15.20	14.83	15.55	17.32	13.92	14.58	16.20	15.28	13.98	18.07	13.70	17.40	15.64	14.15	14.84	13.90	13.84	16.14	16.01	17.08
($Cmolkg^{-1}$)	11.40	15.24	11.86	15.98	14.63	15.34	16.15	15.20	16.95	14.90	14.42	13.06	10.12	16.11	16.84	13.87	11.27	11.68	12.69	13.54
	10.52	16.62	12.34	15.99	14.72	15.34	16.49	14.90	16.95	14.90	16.02	17.03	10.01	16.67	13.84	14.65	11.87	15.30	15.63	16.15
mean	12.37	15.56	13.25	16.43	14.42	15.09	16.28	15.13	12.63	15.96	11.38	15.83	11.92	15.64	15.77	14.14	12.33	14.37	14.78	15.59
SD	2.487	0.938	2.006	0.771	0.438	0.439	0.184	0.200	1.715	1.830	1.187	2.406	3.219	1.323	1.528	0.442	1.344	2.370	1.817	1.835
CV (%)	20	6	15	5	3	3	1	1	14	11	10	15	27	8	10	3	11	16	12	12
Ca^{++}	11.40	11.40	10.80	11.40	10.20	10.00	9.80	10.20	10.40	12.00	8.40	12.00	10.60	10.00	8,80	9.00	11.80	12.40	12.00	12.00
($Cmolkg^{-1}$)	7.20	10.00	9.60	10.00	10.80	10.60	12.40	11.20	11.60	11.20	10.80	9.20	6.20	11.80	11.80	10.20	8.60	8.80	8.80	12.00
	7.20	11.40	9.60	10.01	10.80	10.60	11.90	11.20	11.60	11.20	10.80	12.00	6.20	11.80	8.80	10.20	8.66	12.40	12.00	12.00
Mean	8.60	10.93	10.00	10.47	10.60	10.40	11.37	10.87	11.20	11.47	10.00	11.06	7.67	11.20	9.80	9.80	9.69	11.20	10.93	12.00
SD	2.425	0.808	0.693	0.805	0.346	0.346	1.379	0.577	0.693	0.462	1.386	1.617	2.540	1.039	2.121	0.693	1.831	2.078	1.847	0.000
CV (%)	28	7	7	8	3	3	12	5	6	4	14	15	33	9	22	7	19	19	17	0
Mg^{++}	2.60	2.60	3.40	4.40	2.20	3.30	4.60	3.20	2.00	4.60	3.80	3.60	3.40	2.80	5.00	3.80	1.00	2.60	2.80	3.60.
($Cmolkg^{-1}$)	2.00	3.60	1.40	5.40	3.20	4.00	2.80	3.00	4.80	3.00	3.00	3.20	3.00	3.60	4.40	3.00	2.20	2.40	3.40	1.00
	2.00	3.60	1.40	5.40	2.20	4.00	2.80	3.00	4.80	3.00	3.80	3.20	3.00	3.60	4.40	3.80	2.20	2.40	3.40	3.60
Mean	2.20	3.27	2.07	5.07	2.53	3.77	3.40	3.07	3.87	3.53	3.53	3.30	3.13	3.33	4.60	3.53	2.13	2.47	3.20	2.73
SD	0.346	0.577	1.15	0.577	0.577	0.404	1.039	0.115	1.617	0.92	0.462	0.231	0.231	0.462	0.346	0.46	0.693	0.115	0.35	1.501
CV (%)	16	18	56	11	23	11	31	4	41	26	13	7	7	14	8	13	32	5	11	55

D = standard deviation CV = Coefficient of variability, where < 15% = least variable; 15-35% =moderately variable; >35% = highly variable

Table 5: Sodium (Na^{++}) And Percent Base Saturation Used In Fertility Assessment of the Ramat Polytechnic Farm

Parameter	Location																			
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Na+	0.24	0.31	0.31	0.27	0.31	0.30	0.26	0.34	0.30	0.27	0.25	0.26	0.23	0.34	0.23	0.24	0.22	0.22	0.24	0.24
($Cmolkg^{-1}$)	0.41	0.23	0.22	0.21	0.23	0.27	0.31	0.23	0.20	0.25	0.20	0.29	0.33	0.27	0.26	0.26	0.20	0.20	0.20	0.21
	0.41	0.21	0.30	0.21	0.31	0.27	0.26	0.23	0.20	0.25	0.20	0.30	0.22	0.27	0.26	0.24	0.21	0.20	0.23	0.22
Mean	0.35	0.25	0.28	0.23	0.28	0.28	0.28	0.27	0.23	0.26	0.22	0.47	0.26	0.29	0.25	0.25	0.20	0.21	0.22	0.22
SD	0.098	0.053	0.049	0.035	0.046	0.017	0.029	0.064	0.058	0.012	0.029	0.021	0.061	0.040	0.017	0.012	0.01	0.012	0.021	0.015
CV (%)	28	21	18	15	16	6	10	24	25	5	13	5	24	14	6	5	5	6	10	7
Base	96	97	98	98	97	99	98	98	99	99	98	99	98	98	97	95	98	99	99	98
Saturation	98	99	98	98	97	98	98	97	98	99	98	98	98	98	98	99	98	98	98	98
(%)	97	98	97	98	98	98	98	98	98	98	98	98	97	98	97	98	96	98	98	98
Mean	97	98	97	98	97	98	98	97	98	98	98	98	97	98	97	97	97	98	98	98
SD	1	1	0.577	0	0.577	0.577	0	0.577	0	0	0.577	0.577	0.577	0	0.577	0.577	0.577	0.577	0.577	0
CV (%)	1	1	1	0	1	1	0	1	0	0	1	1	1	0	1	1	1	1	1	0

D = standard deviation CV = Coefficient of variability, where < 15% = least variable; 15-35% =moderately variable; >35% = highly variable

Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na)

Calcium in the study site varied from 6.20Cmolkg^{-1} to 12.40 Cmolkg^{-1} for the soils in all the locations. Esu (1991) gave the critical levels of calcium in soils as values greater than 5 Cmolkg^{-1} as high, based on this rating, the soils of the study area are high in calcium contents, the calcium content was consistently least variable CV (0 – 15%) in all the soil units. Reports have shown that soil pH had a significant positive relationship with Ca^{2+}, which means that increasing soil pH improved Ca^{2+} content (Tomasic *et al.,* 2013).

Exchangeable magnesium values obtained were also high, the results, ranged from 1.00Cmolkg^{-1} to 4.80Cmolkg^{-1} in all locations of the study area. The soil parent materials may be a contributory factor to the high rate of magnesium in the study area (Brady and Weil 2013). The magnesium content was consistently the least variable CV (0 – 15%), except in the soil units 3, 9, and 20, which were highly variable.

Potassium content ranged from 0.27 Cmolkg^{-1} to 1.54 Cmolkg^{-1}, for the soils of the study site, the soils are generally medium to high in potassium content. Burning of residues or incorporation of potassic fertilizers such muriate of potash by research students, influenced the potassium content, the CV was highly variable (>35%) in all the soil units. The concentration of sodium varies from 0.20 Cmolkg^{-1} to 0.41 Cmolkg^{-1} for the soils of the Ramat polytechnic research farm. Sodium is not an essential plant nutrient but is usually recognised in light of its effect on the physical conditions of the soil. Soils high in exchangeable sodium may cause adverse physical and chemical conditions to develop in the soil and may prevent the growth of plants. Reclamation of these soils involves the replacement of the exchangeable sodium by calcium and removal of the sodium by leaching (Landon, 2014). The high values are an indicator of possible hazards of salinity, which might be a result of the high evaporation rate associated with the soils of the arid zones (Brady and Weil 2010), the sodium (Na) content ranged from least to medium in variability.

The Soluble Salts

Excessive concentration of various salts may develop in soils from irrigating water, excessive fertilization, or contamination from various chemicals or industrial wastes. It can also occur naturally. One effect of high soil salt concentration is to induce water stress in a crop, which may result in temporary or permanent wilting. The effect of salinity is insignificant (<1.0 mhos/cm). Readings >1.0 mhos/cm, may affect sensitive plants, and readings >2.0 mhos/cm may require the planting of salt-tolerant plants (Richards, 2012).

Base Saturation

The percent base saturation was found to be in high (Table 5). Chesworth (2007) reported that soils with base saturation of >50 are fertile soils, while soils with < 50 % are not fertile soils. These soils are, therefore, fertile, the Base Saturation were all least (0 – 15%) in coefficient of variability, with base saturation of >50.

Conclusion

The chemical characteristics of the Ramat polytechnic farm established the presence of high fertility status. However, there are dangers of salinity and with improved managerial techniques in combating this hazard will make the soils suitable for most agronomic crops. Parent materials (sedimentary deposits) from which the soils were formed and the frequent use of inorganic/organic fertilizers had influenced the chemical constituents.

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